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ELECTRIC LIGHTING

ITS PRESENT CONDITION.

E. & F. N. SPON, Publishers.

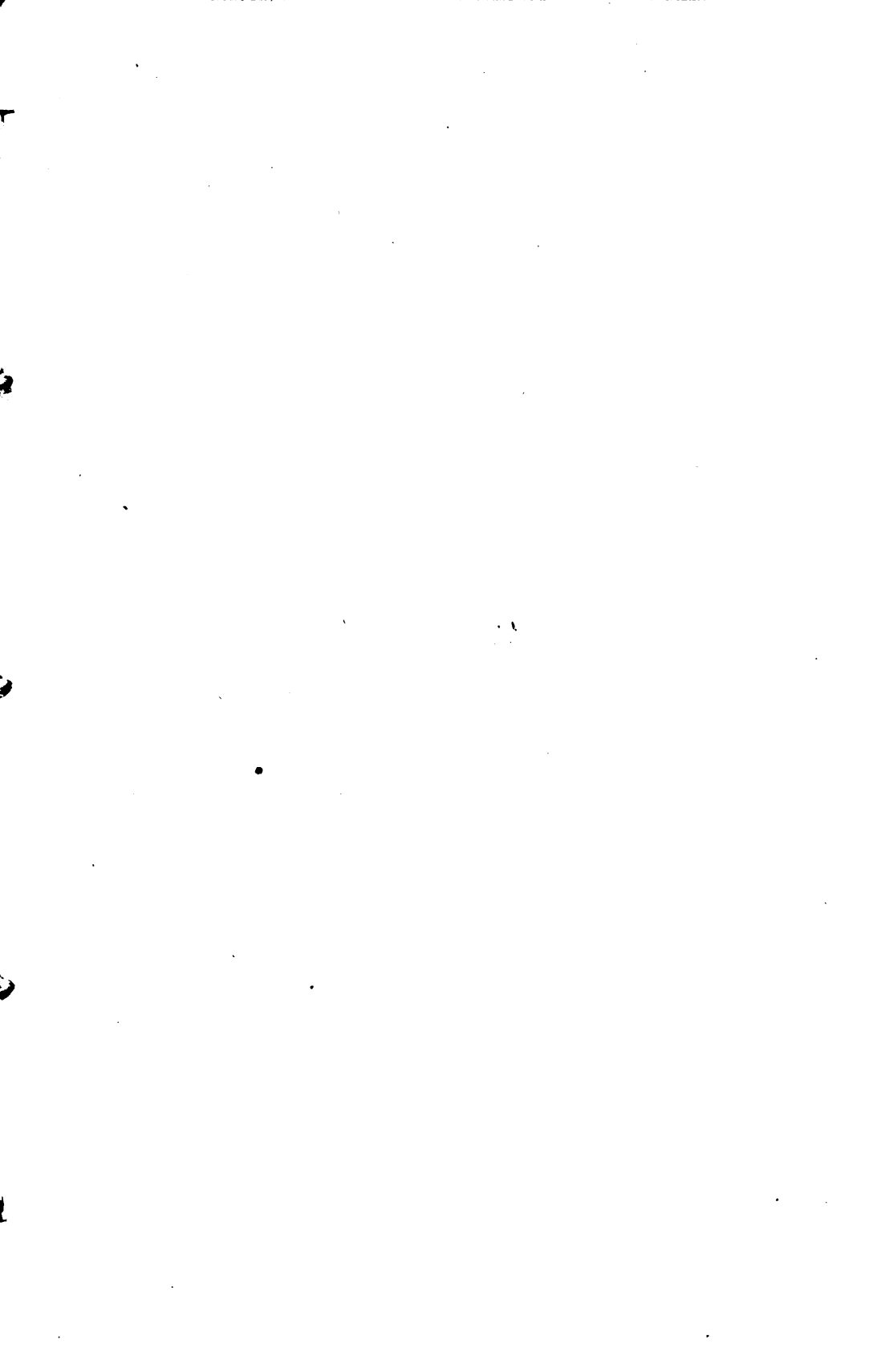
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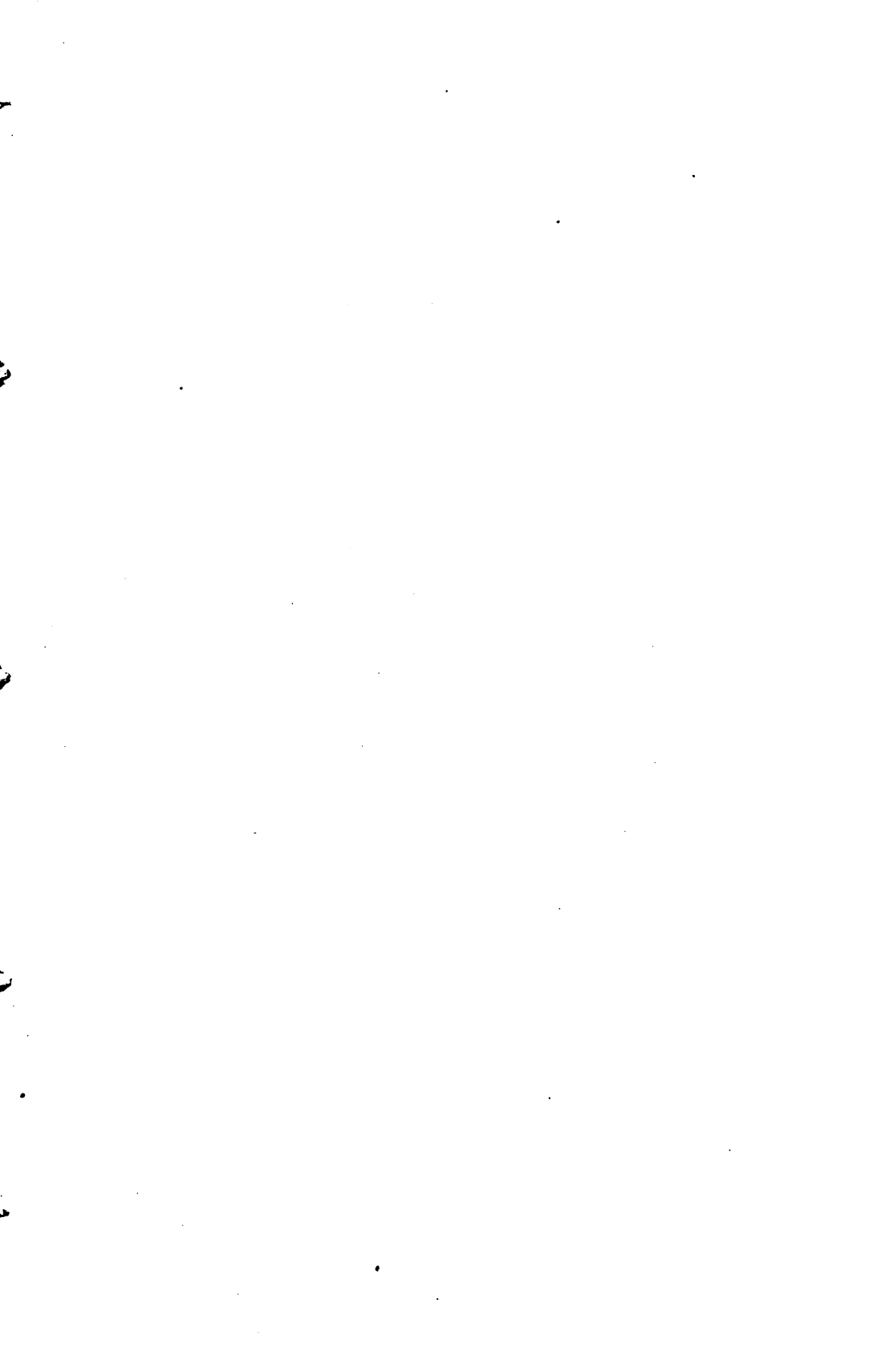
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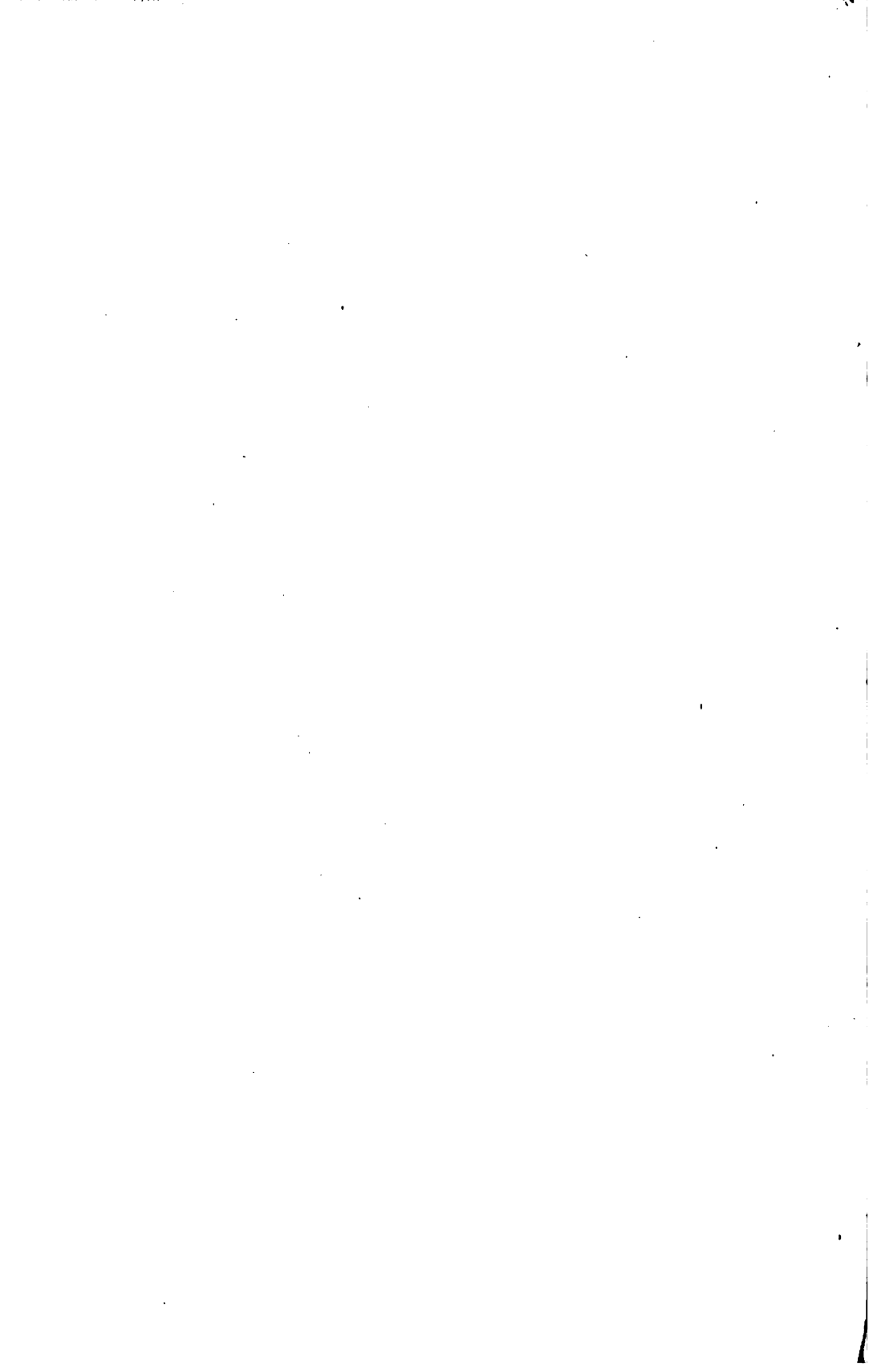
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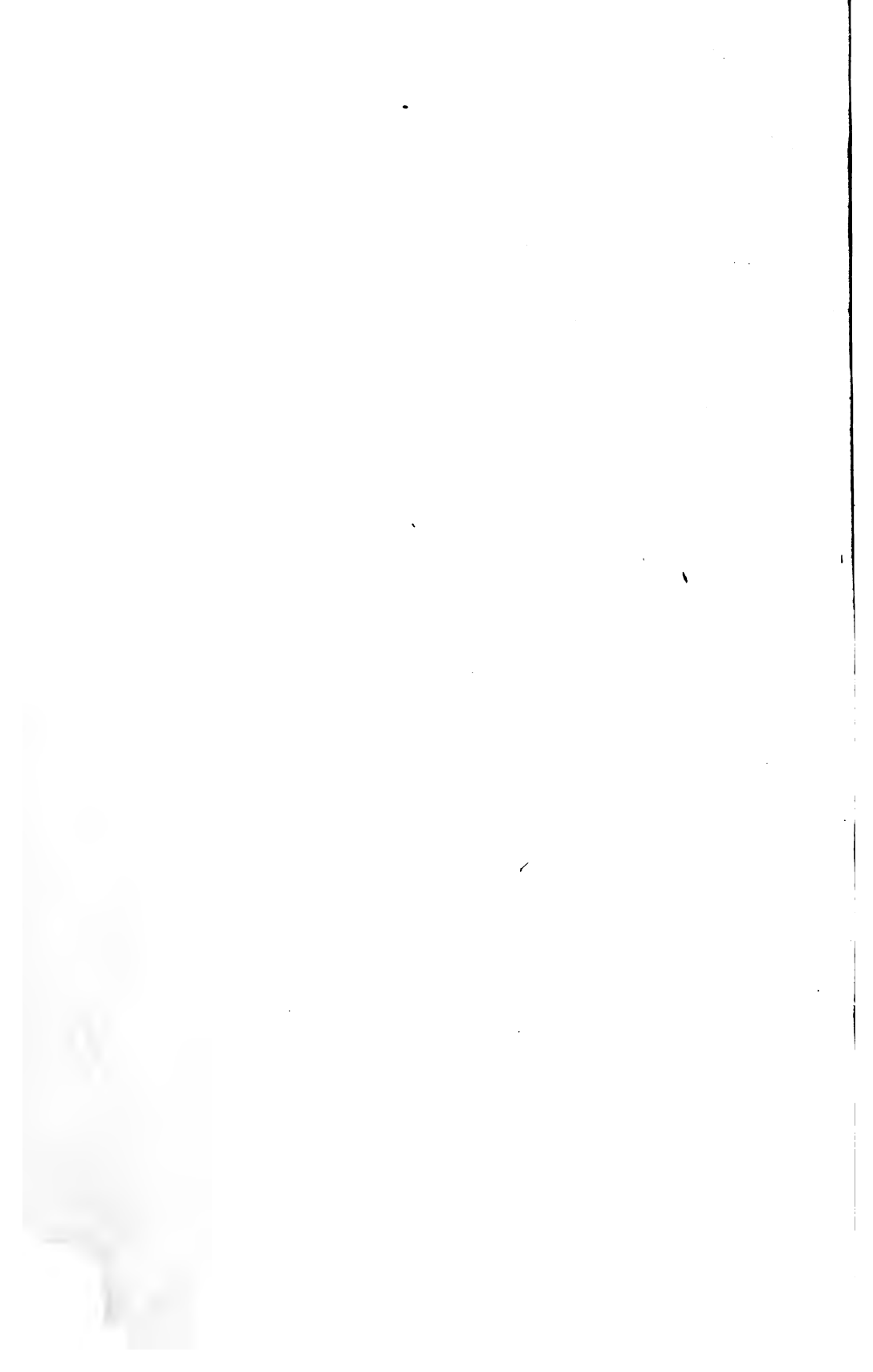


THE
PRESENT CONDITION
OF
ELECTRIC LIGHTING.

A Report made at Munich 26th September, 1885.

BY
N. H. SCHILLING, PH.D.
..

LONDON:
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1886.



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REMARKS

ON THE

PRESENT CONDITION OF ELECTRIC LIGHTING.

GENTLEMEN, — You expect me to give you an account of the present condition of electric lighting, with particular reference to affairs in Munich. I will try to accomplish this as well and amply as possible with the data at my command.

It is, to be sure, a thankless task to speak to-day on electric lighting if one is not prepared to blow with all his might the trumpet of laudation, the noise of which at present fills the world. It will be easily understood how this has come about. At first, it was the real intrinsic interest which the electric light deserves which animated especially scientific and technical circles, and they devoted themselves to its investigation with commendable ardor. But speculation immediately awakened, and sought with feverish haste to obtain control of the new invention for its own purposes. Thus a dangerous element was brought into the healthy development of the subject, the judgment of the great public was confused, and the whole affair turned off into paths of a very dubious nature. For, must we not call it a confusion of judgment when, for example, a public department, in an official document, accompanies a

building permit with the remark "that by that time [meaning the expiration of the permit] gas lighting would be superseded by electric lighting"? And what must we think of electric enterprises, when we read that the sums which during the past year have been lost in them in London alone are estimated at not less than five million pounds sterling? The business side of electric lighting is not in a healthy state, and a great part of the blame must be borne by the false claims put forward. In this way not only electric lighting itself is injured, — for upon exaggerated expectation there must necessarily follow a period of exaggerated distrust, — but gas lighting also is injured, for these efforts to injure it by direct attacks are not without influence upon the public; and every time public opinion is misled, hindrance of technical progress takes place. It is high time that these false claims which are put forth for electric lighting should be met, and I consider it my duty to contribute my mite to this object.

Among the cities of Germany Berlin takes the first place in reference to the absolute number of electric plants which exist at the present day. One of the first was for the benefit of the Ressource and the Union Club, on the street called Unter den Linden. These establishments are supplied by machinery belonging to both in common. In 1882 the lighting of the Leipziger Strasse and Potsdam Square was carried out, at the expense of the city, by means of 36 arc lights, under the auspices of Siemens and Halske. In 1883 an incandescent-light apparatus was set up in the city gas-works, by means of which the factory buildings, the squares, the offices, and the living-rooms, as well as the Schilling Bridge and the street leading to it, were illuminated experimentally by means of about 100 incan-

descent lights. Since that time electric lights have been adopted in several railway stations, restaurants, and shops, where they are operated either by gas-motors or newly constructed steam-engines. A larger plant, for several contiguous territories, is in the Friedrich-strasse, immediately in the vicinity of Unter den Linden, and was constructed by the Deutsche Edison Gesellschaft, and operated at its expense. This supplies altogether about 1,800 incandescent lamps. According to the statistics which lie before me, there are in all 41 plants of arc lights, and 31 of incandescent lights,—in all, 72. Twenty-five of these are worked by gas-motors, and 47 by steam-engines. The number of lamps is not given; but I think that when I call it from 4,000 to 5,000, I have not under-estimated the number. When we consider that the gas-burners of Berlin number 692,716 (namely, 677,845 private burners, and 14,871 street lamps, of which 499 are intensive burners), it will be seen that the electric lights of Berlin number fully one-half per cent of the gas lights. I must not omit to add that two so-called “central stations” are at present in course of construction by the stock company *Städtische Electricitätswerke*. It is said that each of them will supply 7,500 lamps. These establishments will begin operations for the lighting of the royal theatre on the 15th of August, 1885, and for the public, on the 1st of October, 1885.

Electric lighting is relatively more developed in Munich than in Berlin. Munich is at present, in proportion to its size, further advanced in electric lighting than any other German city, and it shows ignorance of facts when the complaint is made that the introduction of electricity goes on slowly, or that we are behind other cities. We have, as far as we have the statistics, at

present 34 plants with 140 arc lights, and 4,045 incandescent lights in use. As the number of gas-burners in use at the same time is 110,993, we see that the electric lights are three and a half per cent of the gas lights, — that is, about six times as large a percentage as in Berlin.

Hamburg has, at present, only 25 plants in operation, with about 80 arc lights and 1,400 incandescent ones. Of these, four establishments, with 25 arc lights and 200 incandescent lights, belong to the Hamburg government and are worked by gas-motors, while the larger private works use steam-engines for power.

In Hanover the large hall of the railway station is lighted by 12 arc lights, the Palmgarten (a concert hall) by 8 arc lights, and in two streets there are 10 arc lights more. Incandescent lights have not been used up to this time.

Bremen has only two electric plants, both with arc lights. These are in the public baths, and the office of the savings bank. The former is worked by steam-power, which was at hand, and the latter by a gas-motor.

In Cologne there are 8 arc lights, and about 400 incandescent lights.

In Leipzig there are three pleasure establishments, three factories, and one shop (for the sale of electric articles) lighted by electricity.

In Dresden there are 14 establishments with 62 arc lights, and 446 incandescent lights in all. Of these, 10 are worked by steam-power already on the spot, and the other 4 by gas-motors.

In Breslau the electric light has, up to the present time, found little favor: only a few restaurants and mercantile establishments are lighted by electricity.

Among the industrial cities of Germany there are

some where the electric light is used in factories to a greater extent. Chemnitz has 17 electric plants, of which 2 are in weaving factories, 2 in spinning factories, 2 in dye-houses, 2 in hosiery factories, 1 in a colored-paper factory, 1 in a machine factory, etc., with, in all, 117 arc lights and 400 incandescent lights, which are mostly worked by the steam-engines of the factories. Crefeld has 69 arc lights and 1,203 incandescent lights, for half of which steam-power, and for half gas-motors, are used. Barmen has 14 establishments with, in all, 81 arc lights and 695 incandescent, almost wholly in factories. Elberfeld has 7 establishments with 9 arc and 126 incandescent lights. Gladbach has in its spinning and weaving factories 15 arc and 230 incandescent lights, for the operation of which steam is exclusively used.

In a large number of German cities only single plants are to be found. According to the data which lie before me, I estimate the number of electric lighting plants in the cities of Germany which are at the same time lighted by gas—that is, exclusive of places lighted by electricity alone—at about 400, with perhaps 1,500 arc lights, and fully 20,000 incandescent lights. The number of gas flames in these cities is fully 5,000,000. We see from this that the number of electric lights does not make one-half per cent of the gas lights.

Among the most important buildings in Munich which are lighted by electricity are the hall for the arrival and departure of trains in the royal railway station, and the royal theatres. The above-mentioned hall of the railway station has been lighted since October, 1879, by means of Siemens differential lamps, and, as gas-motors are used for the production of the current, no business loss has been experienced by us. It is

otherwise with the two royal theatres, which are supplied with electric incandescent light by the Deutsche Edison Gesellschaft of Berlin. At the time of the electric exhibition which took place here in 1882, there were experiments made upon a temporary stage erected in the Glass Palace. In consequence of these experiments, and by the use of the same apparatus, the royal Residenztheater was provided with electric lights, and this method of lighting was inaugurated May 25, 1883. In the year 1884 the introduction of the light into the royal Hoftheater followed; and, since Jan. 18, 1885, the use of gas in both theatres, which formerly was about 180,000 cubic meters yearly, has sunk to a minimum.

Naturally, in the interest of our business, we have very much regretted that we have lost so important a consumer as the theatre. Since the year 1853 the court-theatre has been lighted with our gas without the occurrence of a single accident or interruption of the representations. We have always made it one of our chief objects to satisfy the royal directors. In the year 1869 the whole stage illumination was reconstructed and supplied with 1,912 gas-jets, and we were pleased to hear that we obtained the approval of his Majesty. Later the company made a great pecuniary sacrifice in order to supply the theatre, according to the wish of the directors, with a separate pipe directly from the gas works to the theatre and furnished with its own regulator. When it became known that it was the intention to supply the theatre with the electric light, we did not fail to propose the employment of gas-motors, and to declare our willingness to give our assistance to the royal directors as far as possible. We did not receive any answer to our communication; the electric light was adopted; and on the 18th of January, of this year, the

new lighting was inaugurated without our having received any notice.

As to the reasons which caused the royal directors to give up gas light and adopt the electric light, I, of course, have not been directly informed; but I believe that I do not err when I assume that they are given on the programme of the evening of the first opening with the new light. It reads as follows:—

“The experiments [in the Glass Palace] as well as the experience which has been gained by lighting the royal Residenz-theater, experimentally, for nine months, have so perfectly proved the entire feasibility of employing the electric light in theatres, its advantages with regard to safety from fire, the steadiness and agreeable color of the light, the reliability of its production and use, and the extraordinary improvement in the air of the theatre observed by Dr. von Pettenkofer, that the directors of the royal theatres, with the approval of his Majesty, have decided to intrust the lighting of the theatres entirely to the Deutsche Edison-Gesellschaft.”

In this document the advantages of the electric light mentioned are,—

1. Safety from fire.
2. Steadiness and agreeable color of the light.
3. Reliability of the working of the light.
4. Improvement in the air of the theatre by its use.

In former days it was the custom to praise the cheapness of the electric light, but this point—at least with reference to incandescent light—has now been given up. That incandescent light is an article of luxury has been conceded even by electro-technologists.

Let us examine a little more closely the above points.

As to safety from fire, it is true that the incandescent light, where the glowing carbon thread is shut into a glass globe empty of air (but not the arc light), possesses

a high degree of safety; but the danger lies in another spot,—namely, in the conducting-wires. It is well known that fires often occur in consequence of defective insulation of the wires. It is true that the wires can be laid very carefully in this respect; but, above all, behind the scenes in a theatre,—a place stuffed full of the most heterogeneous objects, where something is always being worked upon or changed, where a great many persons are constantly moving about in the most contracted space,—an accident to the wires easily happens. The electric light needs at least as careful management and watching as gas light, and the experience of years is needed to show which has advantage over the other in respect to safety from fire. The dangers of gas light have been much exaggerated of late. The royal Hoftheater has been lighted for thirty-two years with gas without the slightest accident. If the statistics of fires in theatres are examined, it will be found that the very smallest percentage is caused by gas. Very recently, two theatres have been burned without any blame on the side of the gas companies. On the 10th of March of this year we had a fire in the Hoftheater, which might easily have assumed dangerous proportions. It broke out, according to the declaration of the royal directors, in a room where fireworks (so-called strontium lights) were being kept in an iron box for immediate use. A servant of the theatre, wishing to ascertain what was in the box, manipulated it in such a manner as to cause the ignition of the fireworks.

With reference to the color and steadiness of the electric light, there is no reason, according to my convictions, for seeing advantages in electricity over gas light. Only unprotected gas flames, exposed to currents of air, burn unsteadily, while properly protected

Argand burners burn steadily. It is quite in our power to procure a flame as steady as may be necessary. The light of Siemens's regenerative burner is unsurpassed in steadiness and uniformity, and has been introduced, partly for that reason, in the document room of the Academy of Plastic Arts in this city, and also in the School of Industrial Art. In electric lighting the arc light is, on account of its unsteadiness, entirely out of the question for many purposes, and it is only with respect to the incandescent light that steadiness can be spoken of at all. The color of the electric light, as far as the incandescent light is concerned, is much like that of gas. I am convinced that, if the stage were lighted one evening with incandescent lights, and the next with the same number of gas flames, the greater part of the audience would not notice any difference. It is only where one looks directly into an incandescent light that it seems much more brilliant than gas light, for the reason that it radiates from a much smaller surface. According to Professor Voit's measurements, the brilliancy—i.e., the average mass of light which radiates from the unit of surface of an incandescent light—is to the light of an Argand burner as seven to one; that is, the light of the former is in itself seven times as intense as that of the Argand burner. But, since the illuminating surface of the gas light is just as much greater than that of the incandescent, the gross lighting power of both may be about the same. This circumstance is not an advantage in the electric light, but, on the contrary, a reason against it. In a declaration of Dr. Franz Renk, with reference to the lighting of the Hoftheater, he says, "It may be assumed that incandescent lights excite the retina from seven to twelve times as much as equally brilliant gas light. In this lies a disadvantage

of electric incandescent illumination in comparison with the customary methods of illumination by gas or petroleum. It is true that no serious injury or blindness has as yet been traced to this circumstance; but the Munich oculists have observed that, during and after the international electric exhibition, patients more often come to them with irritation of the retina, and conjunctival catarrh, which could be attributed to the exhibition. In the auditorium of the royal theatre an attempt has been made to counteract this effect by surrounding all the incandescent lights with pear-shaped bell-glasses of ground-glass, so that the glowing wire cannot be seen, but merely a confused image of it. The loss of light from this proceeding is about twenty-three per cent."

How the regularity in the working of the electric light can be affirmed is to me entirely incomprehensible, for here exactly the contrary is true. I will first call to mind the course of events in Stuttgart and Brünn. The Stuttgart court theatre was, on the evening of Feb. 22, 1885, a whole hour without light, because the filling of a grease-box on the piston-rod had been forgotten, in consequence of which the rod became heated. In the new city theatre of Brünn, on the 17th of February, the illumination gave out so entirely that the audience was obliged to go home: it was said because, from a defect in the water-pipes, the conducting cable had become flooded with water. It is rather laughable when the press comments upon such events by saying how wonderfully well the supplementary lights (gas?) acted in this time of need, and it is still more remarkable to hear the reliableness of the electric light praised. If the illumination depends upon whether a machinist forgets to fill a grease-box or not, or whether a cable becomes a little damp, people ought to beware

of speaking of the reliableness of the electric light. The matter stands in fact thus: as long as we cannot keep a supply of the electric light on hand, as in the manufacture of gas, so that, even if the manufacture is interrupted for a short time, we have a reservoir to draw upon, just so long the electric light will be subject to unpleasant interruptions at any time. And even a layman must see that a light which must be manufactured at the moment of its use by means of complicated apparatus—where any hinderance to the sometimes very swift-moving machinery, the breaking or slipping of a transmission-belt, the neglect of a workman, can bring the whole production of light to a sudden stand-still—cannot possess the same degree of reliability as gas light. If gas supply-pipes are protected against freezing, and if the precaution is taken to bring the gas into large establishments at two different points, an interruption is almost an impossibility; and it is with good reason that, in private establishments where the electric light is used, gas lamps are often placed beside it. An establishment which is limited to the electric light is exposed at any minute to be left in darkness; and, in order to limit these interruptions to the very shortest period, every institution should have at least one reserve apparatus, which can be brought into action at any moment. How far the directors of the royal theatres have taken these precautions it lies outside my present task to judge.

I will further mention that there exists a declaration of a commission of the Architects' Union relating to the protection of persons in places of public assembly, in which the following occurs: "The question of illumination is at present in a state of transition, in which the obligatory introduction of the electric lighting, in spite

of the recognition of its advantages, does not seem advisable, since the reliability of the management of the electric light is not yet sufficient."

The most valuable quality of incandescent light is indisputably its favorable influence upon the condition of the air in large assemblies. The air in theatres no longer reaches the same high temperature as formerly, which benefits particularly the public in the galleries, and it remains purer; i.e., it contains less carbonic acid and no particles of smoke. In both these particulars a diminution of real evils has, doubtless, been reached. But the value of the improvement in the air must not be exaggerated; for,—

First, It is not by any means complete; and,

Second, It might have been obtained even with the use of gas light. According to the observations which Dr. Renk has carried on, and concerning which he reports in his sworn statement, the temperature of an entirely full house lighted by electricity rose during representation 7.7 degrees Celsius in the pit, and 7.4 degrees Celsius in the gallery, while with gas light the rise was respectively 11.7 degrees and 12.8 degrees. The proportion of carbonic acid rose with the electric light in the pit to 1.408, and in the gallery to 1.859, while with gas light it rose respectively to 2.611 and 3.282.

What are we to conclude from these figures? Not only that the air has become very much better by the use of the electric light, but also, that, even with the electric light, the rise of temperature is much greater than desirable; and, in the same way, the proportion of carbonic acid rises above that which the science of hygiene shows to be permissible, namely, one-thousandth part.

By means of the electric light the evil is lessened, but not entirely done away with. We have to do, in theatres and other rooms filled with people, not only with the gas flames and their products, but also with the products of respiration; and, as far as these are concerned in the pollution of the air, the electric light can do no good, and the only rational remedy remains an effectual ventilation.

I consider it very gratifying, that, through the introduction of the electric light, the question of ventilation has become the order of the day, for, until now, it has been too much neglected. Ventilation has always been necessary as long as closed rooms have been constructed for the assembling of human beings; but it has never received proper attention. Our ancestors danced in the sweat of their brows, and our grandmothers sat with low-necked dresses and gigantic fans in the theatre. All this was accepted as unavoidable, and nobody thought of the permissible thousandth part of carbonic acid. Now hygiene comes, and says 20 degrees Celsius and $\frac{1}{1000}$ carbonic acid, and no more. Immediately the electric light takes advantage of this, and blows its trumpet of self-praise, saying, "I am the one to bring deliverance; away with the old things, away with gas light!" And, behold, it is really found that with electric light the air becomes cooler and pleasanter; yes, there may even be found ladies who take something warm with them into the theatre. They do not understand how they endured the old conditions so long. That it has been for centuries possible to obtain the same,—nay, much better,—conditions by ventilation never occurs to any one.

Doubtless we must, first of all, reproach the architects that they, up to this time, have laid little weight

upon the sanitary value of constant renewal of air; and even in places like theatres, concert and assembly halls, have provided either no ventilating apparatus or very faulty ones. As soon as pleasant, pure air has become a universal want, these gentlemen will devote their attention to it in a more thorough manner, and it will be found that, no matter what the method of lighting employed, a normal quality of air can be obtained, and that gas light with a good ventilation is much more healthful, complete, and rational than electric light without ventilation. The figures of Dr. Renk show that, even with electric light, the heat and carbonic acid of the air in our royal theatres rise above the normal proportions, and ventilation is really necessary in addition. With a good arrangement for ventilation, without the electric light, it would be perfectly possible to get rid of the products of respiration, and also those of the gas flames, and then to obtain a perfectly normal temperature. Gas lighting is, in a high degree, capable of being used to obtain a vigorous and rapid change of air. We have ventilating burners, whose effect leaves nothing to be desired; but our architects have not, up to the present time, given thought to conveying away the heated and vitiated air; and, for this reason, the burners have not obtained that diffusion and recognition which they deserve. In rooms which do not lie directly under the roof,—where, therefore, pipes or flues cannot lead from the ceiling of the hall through the roof,—there should be in the ceiling channels constructed in such a way as to lead into large vertical ventilating chimneys, which would thus carry off the bad air. In all rooms which lie directly under the roof, the construction of efficient ventilating flues involves only small trouble and cost, and the introduction of a rational ventilation presents no difficulties.

The objection, that a strong ventilation causes, at the same time, an annoying draught, and that, for this reason, ventilation must be reduced to a minimum, and the lighting with gas given up, cannot be sustained, for we have a number of public buildings supplied with gas light in which there is good ventilation without the slightest annoyance from draught. These are chiefly theatres recently built. A ventilation which causes draughts is not properly managed; that is, there is not proper attention paid to the proportions and relation of the entrance and exit of the air. With due recognition of all which has been done by the electric light for the air of the royal theatre, it still remains a question whether it would not have been better to spend the money appropriated to the introduction of the electric light (or, perhaps, only a part of it) for the attainment of rational ventilation.

I cannot omit, in this connection, to speak of the Odeon. Every one knows that the temperature of the great hall of the Odeon, in largely attended concerts, rises to an unbearable height. It is incomprehensible to me that the architects and technologists have not long since introduced a suitable ventilation, for I cannot think that there can be any great difficulties or expense connected with it. The conditions have been investigated by the Royal Hygienic Institute, and a statement of Dr. von Pettenkofer printed in the annual report of the institute says, "From these facts it will be seen that the condition of the air in the Odeon would materially improve if electric light were adopted instead of gas light." I regret that Dr. von Pettenkofer, in his declaration, did not take the opportunity to touch the question of ventilation. It is characteristic that the "Deutsche Edison Gesellschaft" seizes the opportunity

and uses this as an advertisement, saying, "The directors of the royal music school request us to furnish the Odeon with electric light, since Dr. von Pettenkofer has pronounced the condition of the air in the hall of the Odeon injurious to health, and has declared the introduction of the electric light an imperative need." While, in reality, Dr. von Pettenkofer says that the condition of the air would be considerably better if electric light were used, the Edison Company represents the matter as though he had said that it was the only possible means for improving the air, and had, therefore, declared the introduction an imperative necessity. The above sentence of the Edison Company may be found in a petition which was presented by the company on the 26th of February of this year to the magistracy of this city, and which seeks permission to place electric conductors across the streets in erecting central electric stations. Although this petition was not granted, and could not be granted, since it involved the rights secured to our company by contract, I think it my duty to speak a little more particularly of these so-called central stations, since, just now, they are much descanted upon, and form the chief object in many recent speculative undertakings.

I first propose the question, What is an electric central station?

The memorial of the Edison Company gives the following answer: "If the electric light is to become the common property of all, those interested must no longer be forced to construct separate apparatus for their own use only, whose not inconsiderable cost must restrict the benefits of the light to a small group of well-to-do citizens. Rather must the opportunity be offered to every one to obtain what he needs of the electric current,

whether for light or power, or other electric purposes, directly from a great accessible reservoir of electricity. This problem can be solved only by central stations."

According to this, one would think that an electric central station could, like a gas factory, supply a whole city, so that it would be possible for everybody to obtain from it electricity in whatever quantity he needed, and at any time, as one can obtain gas from a gas factory. Besides this, the central station appears, according to the Edison Company, to be a sort of charitable institution, which will supply the less wealthy citizens with the benefits of the new light.

In reality, we find the facts to be as follows: Those parts of a great and busy city are sought out where many rich and elegantly lighted buildings stand together in as small an area as possible. Where, therefore, there is a prospect of a great consumption, a lighting apparatus is constructed for this district which embraces an area of some hundred meters in radius, and this is called a central station. The oldest central station, as is well known, is that in New York, which was constructed by Edison himself, and has existed for years. Dr. Hagen, who undertook a journey to America, at the instance of the magistracy of Berlin, for the purpose of collecting information, and, on the basis of the facts collected, has written a full report, says of these stations, "It is quite incorrect to say that New York is electrically lighted by Edison. New York—that is, the real city up to Central Park—embraces a territory of nearly eleven English square miles; and the whole portion lighted by Edison is not much larger than one-tenth of an English square mile, which corresponds to a circular area of 310 meters radius. The estimate published in the so-called 'Edison bulletins,' edited by

Major S. B. Eaton, president of the Edison Company in New York, and which has spread much further, that the Edison district, No. 1, embraces a territory of an English square mile, is incorrect, and should long since have been corrected in the bulletins." In Edison's district establishment in New York 1,000 hours of candlelight are reckoned at \$1.00. If we take the light power of a gas flame consuming 5 cubic feet of gas as equal to 16 normal candles, and consequently to an Edison light of 16-candle power, we find on the basis of the price of \$2.25 per 1,000 cubic feet, equal to $8\frac{1}{2}$ cents per cubic meter, — the price charged by the eleven gas companies of New York, — that the electric light is about one-third dearer than gas light. According to the latest business report of the Edison Electric Illuminating Company, the tariff seems to have been reduced for a 16-candle power electric lamp to one cent per hour, and the price of gas to \$1.75 per 1,000 cubic feet, so that electric light would be still fully 14 per cent dearer than gas. On this subject the report of Dr. Hagen reads as follows: "The price of the incandescent light, to which the Edison Company calls attention, is about the same as that of illuminating gas, but only on condition that, in order to obtain the same intensity of light as by an Edison 16-candle light, it is necessary to burn $7\frac{1}{4}$ cubic feet of gas per hour. This estimate is, however, in general, as well as for the New York factories, not at all correct." Further on (p. 138), he says, "In most American publications where comparisons are made between the cost of electric and gas light, we always see the price of a 16-candle Edison lamp placed beside an 8-candle gas light. Herein lies a mistake, for every gas expert knows that the relative proportions between the consumption of gas and the light produced are not the

same in large and small flames, and that the effect is relatively much more unfavorable when little gas is consumed than where much is used. Two gas flames of 8 normal candle power are less economical than the 16-candle gas flame. This is the first error which we always find recurring." Further, I will add from the same report, that the widespread idea that Edison's New York central stations furnish motors for small industries is quite incorrect. Up to the middle of September, 1884, not one such motor existed. According to the report of the president, Mr. Eaton, which was read at the last general meeting, the station supplies at present 582 consumers with, in all, 12,503 lamps, and with this does all that it is capable of doing. (According to an address delivered in the "Technical Union" of New York on Feb. 14, 1885, by the engineer, M. A. Müller, the average number of lamps in use is 8,000 only.) Their stock capital is \$1,000,000. Besides that, there is a loan of \$70,000. The balance-sheet of 1884 shows a profit of \$35,540.40 to pay the interest on this capital, while the year 1883 showed a loss of \$4,457.50. The president cherishes the best hopes for the future; would be glad to organize a second central station; and claims that, as this would be located in a far more favorable district, and could be organized at about half the cost of the existing station, there would be a certain prospect of 15 per cent interest on the capital required; but he renounces the idea of calling this enterprise into being, because, on account of the universal depression in all electric enterprises, the present moment does not seem favorable for increasing the stock capital of the company.

Besides this, there exist in New York two stations of the Brush Company, whose working is limited to

about 1,800 arc lights, and three stations of the United States Electric Light Company (Weston System), which feed together 975 arc lights, and 2,500 incandescent lights.

The connecting wires of the two latter companies are carried along above ground, but there has just been a law passed obliging them all to be placed under ground before Nov. 1, 1885. This measure, it is said, makes it almost impossible for the electric companies to extend their plant.

Of Berlin we can, at present, only say that the Deutsche Edison Gesellschaft has closed an agreement with the magistracy, according to which it is permitted to the company to lay their wires in a circuit of 800 meters radius whose central point is the palace of the prince in the Kurstrasse. These wires are to serve as conductors for one or more central stations, and the company is allowed to use the street bridges and sidewalks for laying them. The contract was given on the 19th of May, 1884, to a local company, called Actiengesellschaft, Städtische Electricitätswerke, with a stock capital of \$750,000, whose object is described as the industrial employment of the electric current for lighting and transmission of power within the present and future limits of the city of Berlin. Besides a couple of "block stations,"—that is, apparatus for several contiguous buildings for which it will not be necessary to use the public streets for laying wires,—there will be a central station in the Markgrafenstrasse at No. 44, and they also speak of another to be erected in the Mauerstrasse. From the report read at the general meeting of the 13th of April, 1885, I infer that the central station will be opened in the course of this year, and that the dividend of $2\frac{1}{4}$ per cent which has been paid resulted from placing

at interest the paid-up capital which has not yet been used. This society will charge for a 16-candle power lamp the sum of one cent per hour. Besides this, the consumers have to pay for every lamp placed in their houses the sum of \$1.50 yearly.

A central station of the Società Generale Italiana di Elettricità Sistema Edison in Milan, which has been in operation since June, 1883, and which is situated on the site of the old theatre Santa Rodegonda, in the immediate vicinity of the cathedral, comprehends a territory in which the greatest distance of the points to be illuminated from the station is 630 metres. The company receives, upon an average, an annual tax of \$7 per lamp of 16-candle power, and besides that a little less than one cent per hour when the lamp is burning. On the 1st of January, 1885, 5,530 lamps were supplied by it. In spite of this, according to the annual financial report for the year 1884, read the 29th of March, 1885, at the general meeting, there was a loss for the year of about \$15,000. This with a capital of \$600,000, of which \$120,000 are not yet bought by the public.

These examples may be enough to show how little the really existing central stations correspond to the description given in the petition which the Edison Gesellschaft presents to the magistracy of our city. It is entirely false that the electric central stations make the electric light common property, and that by means of them the opportunity is given to every one to take what he needs of the electric current from a great centre accessible to every one. The phrase, also, that the central stations make the benefits of the electric light attainable by less prosperous citizens, is an unskilful piece of self-praise which has no foundation in truth. In the sense in which gas factories are central stations for the lighting

of our cities there is not, and never can be, an electric central station.

As long ago as the general meeting of the 26th of September, 1882, I emphasized the fact that, at that time, not even one expert was of the opinion that it could ever be possible to light a whole great city, its suburbs, and outside districts with electricity as it is now done with gas; but that we could only speak of central stations which supply a limited district not greater, in any case, than an English square mile. And even in such districts, the affair cannot be carried on unless the conditions of consumption are unusually favorable (perhaps 50,000 lamps to an English square mile).

In gas lighting we are able to carry the illuminating material with not too great cost in pipes through the streets of a whole city, and it is at the service of consumers night and day in the most convenient form. From the circumstance that there is always a large quantity of gas stored up in the gasometers, we not only supply the consumers reliably, but this also enables the operations of the factory to be carried on regularly and continuously. Besides this, in gas manufacturing we have to do with a real productive industry, by means of which, by the perfection of methods and apparatus, by the careful utilization of subordinate products, a series of economic results can be obtained. Moreover, it is possible to place the gas factory outside the regular lighting districts on comparatively cheap land. This is all quite different in electric lighting. Electric currents, such as are needed for lighting purposes, cannot be well carried to a great distance, since the cables are too large and too expensive. For this reason alone the districts supplied must be limited in extent, and it is not possible

to supply a whole city from one point. Besides that, the electric current cannot be generated and kept on hand, since the so-called accumulators have not reached a practical development, and the companies are thus unable to furnish consumers reliably, but must measure their production by the consumption, — that is, must produce, at the moment when it is required, the current necessary for the use of the lamps. That this circumstance does not contribute to make the operation economical is evident. In an address of Prof. G. Forbes on central stations, he says, "The first thing which must be considered when a central station is contemplated is the probable consumption in different portions of the district. This is a hard problem, which can seldom be solved quite accurately beforehand; and it will, therefore, be well if the electrician, in estimating this portion of the outlay, gives a certain latitude to his computations, in view of a possible error. It is just as difficult to estimate the probable amount of consumption for certain hours of the day and for certain seasons of the year. In fact, up to this time, the construction of central stations has been carried on in a most reckless way: the dimensions have been as chance may have ordained, and they have then been changed here and there until a piece of patchwork was the result."

Further, the carrying-on of an electric establishment is not a real productive industry. A raw material is not converted by manufacturing methods into a product whose economical production is only possible on a large scale; but it is only the question of the setting-up or managing of certain machines, which do not need any thing but room to stand and men to tend them. For this reason it is necessary to place the machines as near as possible to the places to be illuminated; and

cheap land at some distance cannot be used for the apparatus, but it must be placed in the midst of the most elegant and populous districts; and great difficulties and expense are met with in placing steam boilers, often of several hundred horse-power, without complaints and protests from the neighborhood. In short, it must be concluded, from all these grounds, that electric lighting, from its very nature, is not fitted for distribution from one centre.

But such central operation is not a real necessity. While it is impossible that each consumer should make his own gas, it is not impossible at all for each to produce his own electric light. In very many cases, where in the place to be lighted there is already motive power, this will be used to the greatest advantage. When I go about among the electric establishments in Munich I find that, with the exception of the central railway station and the royal theatres, almost all are worked by already existing steam-engines or water motors. The railway station and theatres are large enough for independent motive power; and the others do not need a central station, since they work cheaper with their own motors. The remaining establishments which cannot use their own motors lie so widely separated that a central station would do them no good. A so-called central station could claim that it had the advantage that the production and management of the electric current was cheaper in large establishments than in small ones, were it not the fact that the expense is greatly augmented by the very costly stout copper wires required; and, in reality, the expense would thus be increased rather than diminished. At any rate, proof must first be given that central stations can work more cheaply than individual apparatus. And, even if this

were the case, we must consider that those who organize central stations will want a profit from their enterprise, while the individual manufactures his own light at first cost. The convenience of a central station lies in the fact that the consumer has nothing to do with the management of the machines; but this is of comparatively small importance, since, when machines are already on the spot, the service must be attended to in any case, and, if gas-motors are used, the attention needed is so slight that it is scarcely worth mentioning. Individual establishments have the advantage that the setting in motion or stopping of the machines is entirely under their control, and they can produce their light as it is needed.

According to the above, we cannot wonder if the results which have been obtained with central stations are far behind the expectations with which they were called into existence. I have already mentioned the yearly balance-sheets of certain companies, from which it is seen that they, even under the most favorable circumstances imaginable, and having a small and lucrative quarter of the city for their operations, have only been able to achieve a loss, or, at most, an inconsiderable gain. And, in considering this, we must remember that the income of these enterprises comes not alone from furnishing light, but also from the sale and setting-up of fixtures, from which, at any rate, the gains must be considerable.

Dr. Hagen says, in his already quoted report on the New York central stations, "What the pecuniary results of Edison's central city lighting will be is still unknown. In the mean time it is said that the company now find it as hard to obtain buyers for its stock as it was easy in the beginning. It is universally said that Edison's

central stations do not pay well at present prices. The conditions are doubtless much less favorable than for single establishments, since the subterranean cables represent so enormous a value, and call for the outlay of so much more capital."

In Berlin, on the occasion of the negotiations regarding the permit desired by the Edison Company, in the session of the city representatives, on the 4th of December, 1884, the head bürgermeister, Herr von Forkenbeck, declared, "It is certain that electric lighting which is managed from central stations is a very risky business, and that it is, therefore, not at all to be recommended that the taxes of the community be employed in it." A stockholder of the Metropolitan Brush Electric Light and Power Company in London expressed himself quite forcibly in the general meeting of the company on the 12th of February, 1884. "I believe," said he, "that it is an open secret for the greater part of those engaged in electric lighting, that no electric central station pays. And if, of which I am fully persuaded, this electric lighting is a failure, the sooner the public is enlightened on this point the better for its pockets."

In order to understand the conditions correctly, it is necessary to look more closely at the business foundations upon which the operations of electric central stations, and electric lighting in general, are based. I will first quote the utterance of an English electric journal, "The Electrician," of the 19th of April, 1884. "When we turn," it says, "from the scientific and technical standpoint to a business view of the situation, we find the present conditions extraordinarily unsatisfactory and utterly disappointing. Great immediate consumption and a corresponding profit were predicted for the

lighting companies, which were hastily organized as soon as scientific success seemed assured. The present state of things shows a total want of business, and, in consequence, melancholy balance-sheets. Companies which seemed to begin under favorable auspices have sunk to a state of complete inactivity, because they find no opportunity to employ their capital. Others, unhealthy from the start, have either ceased to exist, or lie in the last agony. Signs of vigorous life are nowhere to be seen. A few companies are somewhat employed in erecting small plants, but these can be counted on the fingers of one hand. Besides, this is not the employment upon which we had reckoned, or from which we can expect success," etc.

In another place, on the 15th of March, 1884, the same journal says, "The business of electric lighting is ruined by the sins which commercial immorality has committed. The misguided public, which yielded to the temptings of speculators, and still more to the secret and open promptings of so-called experts, is to be pitied. The mere speculator has no character to lose,—he stands in public opinion about the same as he did before; but it is different with the scientific world, and it will be a long time before the public will regain its confidence in the men whose declarations and estimates have so utterly deceived it."

That the complaints concerning the bad situation of the electric lighting companies is well founded one can easily be convinced. The French journal, "*La Lumière Electrique*," gives a list of the market standing of electric securities from which I extract the following:—

	Share Capital.	Number of Shares.	Paid-up per Share.	Last Quoted Price.
British Companies:				
	£		£	£
Anglo American Brush Electric Light Co.	137,010	13,701	7	2
Anglo American Brush Electric Light Co.	215,992	26,999	10	3½
Australian Electric Light and Power Storage Co.	249,000	24,900	3	½
Brush Electric Light et Power Co. for Scotland	In liqui- dation	—	2½	½
Eastern Electric Light and Power Co.	148,820	30,000	4	1½
Edison and Swan United Electric Light Co.	1,000,000	200,000	2½	½
Great Western Electric Light and Power Co.	124,900	24,980	2½	½
Hammond Electric Light and Power Supply Co.*	200,000	40,000	2½	½
Maxim Weston Electric Light Co. Metropolitan Brush Electric Light and Power Co.	172,500	172,500	1	½
200,000	40,000	3	—	
Pilsen Joel General Electric Light Co.	200,000	40,000	2½	—
American Companies:				
	Dollars.		Dollars.	Dollars.
Brush Electric Light Co.	1,000,000	10,000	100	80
Edison Electric Illuminating Co. .	1,000,000	10,000	100	60
Edison Electric Light Co.	1,080,000	10,800	100	90
Edison Isolated Co.	1,000,000	10,000	100	70
Fuller Electrical Co.	870,000	8,700	100	20
Swan Electric Light Co.	600,000	6,000	100	40
United Globe Electric Light Co. .	6,000,000	60,000	100	85
United States Electric Lighting Co.	1,500,000	15,000	100	95
French Companies:				
	Francs.		Francs.	Francs.
Société Industrielle et commer- ciale Edison	1,500,000	3,000	500	—
Sté Lyonnaise de const. méc. et Lumière électrique	5,000,000	10,000	500	—
Compagnie Continent. Edison . .	1,000,000	400	2,500	—
Compagnie électrique	1,500,000	3,000	500	—
Compagnie Parisienne d'Eclairage par l'Electricité	5,010,000	10,020	500	30

* Now in Liquidation.

	Share Capital.	Number of Shares.	Paid-up per Share.	Last Quoted Price.
Compagnie Universelle d'Electricité Tommasi	2,000,000	4,000	500	—
French Electric Power Storage Co.	28,875,000	75,000	25	} In liquidation
French Electric Power Storage Co.	—	100,000	250	
French Metropolitan General Electric Co.	30,000,000	120,000	250	
Société anonyme d'Electricité . .	600,000	1,200	500	—
Société électrique Edison . . .	1,000,000	2,000	500	—
Société l'éclairage Electrique . .	6,650,000	13,300	500	75

I add a few facts from the reports at the annual meetings of English companies.

The balance-sheet of the Edison and Swan United Electrical Light Company of the 30th of June, 1884, showed a loss of £28,000.

In the annual meeting of the Great Western Electric Light and Power Company, on the 6th of October, 1884, the balance-sheet presented showed a loss of about £1,067.

In the annual meeting of the Anglo American Brush Electric Light Corporation of the 4th of February, 1885, a profit of £4,127 was shown, and a dividend proposed of $2\frac{1}{2}$ per cent, but it was finally resolved to give up paying the dividend.

In the annual meeting of the Maxim Weston Electric Company on the 18th of February, 1885, a dividend of 5 per cent was even proposed, but the proposition was also made and accepted to pass the dividend. The author of the proposal says, "I am, like stockholders of all other companies, anxious to taste blood, and was pleasantly surprised, in reading the report, to learn of the prospect of a dividend, for the experiences with electric companies have not been favorable in this par-

ticular. But in the interest of the stockholders, I now think it better not to pay a dividend."

In an extra general meeting on the 17th of June, 1885, the Hammond Electric Light and Power Company, which had shortly before made a contract with the city of London for lighting extensive portions of its streets, decided to dissolve. In the report which was laid before the company, the directors say that since the last regular meeting they have taken all possible pains to stimulate the use of the electric light, and in the spring succeeded in making a contract with the commissioners of sewers for lighting the streets of London. In spite of this valuable concession, the directors have not succeeded in finding capitalists willing to supply the means needed to erect the central station and to carry on the necessary work. It is true that we have organized in Brighton, Eastbourne, and Hastings local undertakings which doubtless will pay in a few years, but the work of establishing them has called for great outlays, and entirely absorbed the funds of the company (\$1,000,000); and, as to erecting isolated establishments, it has been found quite impossible to find profitable business in that direction. The result of this is that the company is no longer able to carry on its business and fulfil its engagements; and, as the directors do not see any probability of such a lively demand for electric articles in the near future as to promise a profitable business, it seems for the interest of all concerned to dissolve the company.

On the 11th of June, 1885, the dissolution of the Provincial (Brush) Electric Light and Power Company and of the Southeastern (Brush) Electric Light and Power Company was decided upon.

Many more similar examples might be found.

The reason of the whole calamity lies plainly in the fact that capital is engaged in electric undertakings in a quantity so great as to bear no relation to the business to be done.

The real sound basis of the business of electric lighting lay, from the beginning, and still lies, in the manufacture and sale of machines and lamps, and we Germans can, with satisfaction, emphasize the fact that we can call the most important firms in this branch of the business our own. As long as the business was limited to producing by scientific and practical labor the best machines and apparatus and introducing the same, and to doing this with proportionate capital, it was, and remains, healthy and lucrative. But they did not wish to stop there. A number of men who had made themselves known by more or less valuable inventions got into the hands of speculators, and sold their patents to companies. Immense sums were paid for often quite worthless patents, and the imagination of the public in general was inflamed by speculation to such an extent, that, no sooner was a patent taken out, than a company was formed to bring together a great capital for its introduction. When I run over the lists of electric-lighting companies formed in England, I find, for example, that, in 1882, 41 companies were incorporated, with a stock capital in all of not less than £15,500,000. "The Mercantile Shipping Gazette and Commercial Review" for 1884 gives in its annual supplement a report on the electric companies then existing in England, and finds that there were 69 of them, with a capital in all of £24,895,500. Of this capital, £9,928,446 were put into circulation (into the business), and the inventors received as a royalty, in cash, £1,828,181, and in stock, £5,209,241. It is estimated that of the

invested capital, and that still to be paid up, not less than 40 per cent was used to pay the inventors, and that the real working capital would have to bring in 23 per cent in order to pay 5 per cent on the stock capital.

What have the companies done with these great capitals? As soon as they had bought the patents, they began with the manufacture of machines and apparatus. Then they commenced the work of setting up apparatus; and, as this was not enough to employ the capital, they took in hand also supplying the light itself, and the formation of central stations. With every step they went farther away from the basis of the business. The manufacture of the machines and apparatus was rendered expensive by the prices paid for the patents,—the work of setting up is itself only a secondary business, and could be carried on with a comparatively small capital,—and so far nothing has been earned by the supplying of light. Many companies have tried to help themselves by forming smaller companies, or whole generations of companies where the younger ones were made tributary to the older ones, until they came upon the idea of local companies which should begin a direct competition with the gas companies by the erection of central stations, and the monopoly of patents for single cities.

It is interesting to hear how the electric business world already speaks of these so-called auxiliary companies. In the annual meeting of the Anglo-American Brush Electric Light Corporation of the 4th of February, 1885, the chairman mentioned "that the company had been lucky enough to re-absorb several auxiliary companies. Originally the idea of auxiliary companies was a good one, for it was a great advantage for the mother company to have local companies working for it

in the capital and provinces, if they succeeded thereby in getting customers for their central factory. But the dream has not been fulfilled; and, in reality, there is no need of auxiliary companies."

In Germany we have, as far as I know, only the Deutsche Edison-Gesellschaft in Berlin, and the stock company founded by this, and called Städtische Electricitätswerke.

I will not attempt to criticise these, for the former has been working only a short time, and the latter has not yet begun work. I will only mention a few facts for information. The Deutsche Edison-Gesellschaft was formed on the 19th of May, 1883, with a capital of \$1,250,000 in 10,000 shares, which have been sold at market price of 112 per cent. The company is dependent on the Compagnie Continentale Edison in Paris. They paid this company, for the use of their rights, \$87,000 in cash, and gave it further 1,500 certificates, which, with 1,000 other certificates of the same kind, give a right, after the payment of a dividend of 6 per cent upon the paid-up capital, to the appropriation of 35 per cent of the profits. Besides this, a percentage is charged for each horse-power set up, and for every lamp sold. How far the Paris company may be in its turn tributary to the American is unknown to me. The local company, Städtische Electricitätswerke, has assumed the obligation of buying all its machines and fixtures from the parent company. Besides that, it must pay the city, for the privilege of laying wires in a district of eight hundred meters' radius, at first 10 per cent of its gross income (not of its net profits); and, if it pays a dividend of over 6 per cent, it must pay 25 per cent of its extra earnings.

How heavy the expenses will be with which the con-

sumers will be loaded under these conditions, I leave my readers to compute for themselves. When the Edison Company, in its proposal to our city magistracy, affirms that the magistracy of the city of Berlin, in full appreciation of these circumstances (that is, the advantages and benefits to be obtained only by the erection of central stations), has approved the erection of central stations, I cannot omit to remark that this approbation proves, in my opinion, nothing at all. The city has, without assuming the slightest risk or labor, for the simple privilege of using the earth of its streets for electric conductors, assured to itself 10 per cent of the gross income of the company. Whether the city has in this way served the interests of the citizens seems to me questionable.

I now come to the chapter of street lighting by electricity. It is known to you that the electrical exhibition of the autumn of 1882 yielded a financial surplus of some \$5,000. By a document of Dec. 29, 1882, the Polytechnic Union was given \$5,250 under condition that an electro-technical division should be formed in its committee, in which should be a representative of the royal ministry of the interior and of the ministry of state and foreign affairs, or a member of the royal board of directors, also a representative of the city government, two experts, and two scientific men. This commission was formed on the 21st of February, 1883, and consisted of twenty-one gentlemen with Prof. C. Voit as chairman. A statute of the commission gives its object as follows: By means of electro-technical experiments, by examinations and surveys, by the giving of certificates and the solution of problems, by lectures and publications, to make official bodies and individuals acquainted with the

various uses of the electric current and with the value of new achievements in the domain of electricity; and, finally, to promote the interests of electricity in every way. As means for the commission there were given them the above-mentioned \$5,250 and whatever additions and contributions might be made from time to time, either by public bodies or private persons, for the advancement of electricity. The fund itself must remain the inviolate property of the Polytechnic Union, and only its interest can be used for the purposes mentioned.

Upon a petition of the commission, dated April 10, 1883, the city magistracy resolved in the session of May 1, 1883, to allow them, as soon as the new water-works should be finished, to take the pump-house, No. 36 Blumenstrasse, with about twenty-five horse-power, for their experiments without the payment of rent. They were to be allowed to alter the water-works (the old ones) as might be necessary for their purposes, but they were to assume the obligation of restoring every thing to its old condition when they left the house; or, if the magistracy preferred, they were to let them have their new establishment free of charge. Notice to quit could be given them at the expiration of a year. This resolve of the magistracy was approved by the delegates of the city in their session of May 16.

On the 30th of May, 1884, a project of the commission was discussed which rested on a proposal of the firm of S. Schuckert in Nuremberg, and was in its principal points as follows: A turbine apparatus was to be erected in the pump-house, by means of which 16 arc lights were to be operated,—4 on the Marienplatz, 4 on the Meuhauserstrasse, 3 on the Kaufingerstrasse, 2 in the Weinstrasse, and 3 in the Theatinerstrasse. The whole establishment was to be installed by Mr.

Schuckert, and ceded by him for six months' use. The city of Munich indemnifies Mr. Schuckert for setting up and taking down only with about \$300; undertakes the foundations and the setting up of the candelabra itself; and only pays Mr. Schuckert for the cost of operation the sum which the gas lamps (about 110 flames), which can thus be dispensed with, would have cost. It was resolved to negotiate with the electro-technic commission; and the firm of Schuckert, on these terms and this resolve, was approved by the college of city delegates on the 11th of June.

In the mean time a communication of the magistracy had been handed to our company with reference to a possible introduction of the electric light, and the preliminary question was raised whether the contract existing between the company and the city government would be a barrier to free negotiations on the subject. It was remarked by the magistrate that a perusal of the contract of Aug. 25, 1863, had convinced him there need be no hesitation as regarded the contract, either in taking the matter in hand himself or giving it to a third person. Your council and directors resolved, in their sitting of May 14, to obtain first a legal opinion; and, after having so done, the magistrate was answered on the 14th of July that we had never doubted for a moment that the gas-light company is alone entitled to illuminate the city for thirty-six years, and that the company must insist that this contract be not violated. This difference of opinion led to the postponement of the experiments, and the formation of a court of arbitration, as provided for in the contract. This court of arbitration has now, on the 2nd of June, given the following decision:—

1. The complaint of the city of Munich of the 8th of

November, 1884, is rejected, and the complainant must bear all the expenses of the legal contract, and, particularly, must indemnify the gas-light company for the costs incurred.

2. The value of the object of contention is placed at \$500,000.

The complaint read as follows:—

“The defendant ought to acknowledge that, according to the contract, there is no reason why the city government should hesitate to take into its own hands, or give to a third party, the use of electricity for purposes of public or private illumination of the city streets and squares; and ought also to bear all the expenses of the legal contest, and to indemnify the plaintiff.”

I select the following from the reasons given for this decision:—

“The city of Munich has the duty, in the interest of public safety and of business, to light the public streets and places; and, since this is a question involving the advantage of all members of the community, the city also has an exclusive right to do so.”

Up to the year 1848 the city government took charge of lighting the city with tallow and oil.

When the lighting of the streets with gas was adopted elsewhere, the city of Munich also resolved to introduce gas lighting; but, as this method of lighting was more complicated,—since not only must the lighting material, the gas itself, be manufactured, but the conducting pipes must also be laid, and the manufacture and use of the gas must be subjected to uniform supervision,—they did not limit themselves to requiring the gas to be supplied in sufficient quantities, but resolved to give out the lighting of the city in general by contract, as can be seen, without any doubt, in the preliminary writing of the city magistrate of the 17th of December, 1847.

This writing led to a contract on Oct. 31, 1848, with the banker Kohler in Geneva, with whom, later, the banker Von Eichthal associated himself, and which reads in Section 1, word for word, thus:—

“Banker Kohler undertakes the lighting of the public squares and streets of Munich with coal gas for the term of twenty-five consecutive years.”

Since it had been stipulated in Section 23 of this contract that after the expiration of fifteen years the city had a right to acquire the gas factory, with all its apparatus, for the manufacture of gas and for illumination, it was debated in the city government whether it would make use of this latter right. After manifold deliberations it was decided not to do so, and a contract was made with the gas-light company on Aug. 25, 1863, which still remains in force, and whose first paragraph reads as follows:—

“The gas-light company undertakes the continuation of the lighting of the public squares and streets in Munich with coal gas for thirty-six years, according to the terms of the contract made with it on the 31st of October, 1848.”

The wording of both these paragraphs speaks plainly the intention of the contracting parties, and leaves no doubt concerning the rights and obligations of both.

Whether this contract is understood by the law as a delivery contract, or as a *locatio conductio operis*, or as an innominable contract, so much is fully evident: that the gas company from the 25th of August, 1863, undertook, for thirty-six years, the obligation of lighting the streets and squares of Munich with gas, and, that the city is bound for the term agreed upon to allow the lighting of the city to be done by the gas-light company exclusively, since, according to legal decisions, and the principle of fidelity

and confidence, *bona fides*, which rule our whole system of contract, it is self-evident that the party which causes certain services to be promised by the other for a certain length of time also binds itself to accept these services for the future as far as agreed upon, and to pay the price mentioned in the contract.

An assumption contrary to this would endanger our whole present system of contract,—yes, would do away with it entirely,—for who would bind himself to render services for a term of years (especially when they involved large and costly establishments to be organized) if the other party to the contract were empowered to withdraw at any moment, and cause all this expense to have been incurred in vain?

But if, as is not the case, the sense of the above paragraph were to be misunderstood, a large number of contract decisions would speak for the above understanding of it. (Here a number of paragraphs of the contract are mentioned, and the history of their origin given.)

The extent and purpose of the fourth section of the contract has also been entirely misunderstood by the plaintiff.

While the first deliberations on the introduction of gas lighting were going on, the city government thought that it could claim a monopoly of the supply of gas to private persons; but when it was ascertained that this was not the case, they nevertheless endeavored to shield the undertaker of this great enterprise as much as possible from damaging competition, and the magistracy bound themselves for the duration of the contract not to give up the public streets for the laying of gas-pipes to any third party.

It is true that this was a very important concession

to make to the gas company, but it was considered necessary in order to obtain for them as much as possible of the private consumption of gas, and thus to aid the undertaking, as the city had a great interest in the continuance and prosperity of the company on account of the street lighting undertaken; for it cannot be denied that irregularities and disturbances in the management of the gas factory are calculated to produce a series of inconveniences and dangers to the city itself.

There has been an effort made to lay weight on the point that only the lighting of the streets with *gas* was conceded to the company, and that this did not hinder the introduction of electric lighting, since this could take place without violating the conditions of Section 4.

This sort of interpretation is entirely contrary to good faith, *bona fides*; but, besides that, the city has bound itself, for thirty-six years, to have the streets lighted with gas (excepting the provisions of Section 16), and must do this in fulfilment of the contract, since a contrary behavior would involve a flagrant breach of contract.

But, most of all, there speaks against the conclusion of the plaintiff the fact that the whole public lighting of the city in all its branches was committed to the defendant, the evidence for which is found in the circumstance that the latter lights those districts with oil or candles where gas-pipes have not yet been laid.

The lighting of certain streets or squares by electricity, even when the defendant is not interfered with, cannot be reconciled with the above right.

It cannot be said that the contract must not be understood in the sense in which the defendant understands it, since that would prevent the possibility of introducing new inventions into the street lighting of Munich.

For this possibility is anticipated in Section 16, which provides that if a new method of lighting be discovered or rendered capable of use, which has advantages over the present system in respect to brightness, purity, or steady burning of the light, or which is cheaper in production or in other respects, the gas company shall, at the wish of the city government, make a fair agreement to introduce the light in the streets and in private lighting, after the same shall have been proved of practical worth in use on a large scale.

This very section is a proof that the magistrate was aware that, in giving the right of lighting the city to the gas company, he had also given the right to use another kind of illumination, and therefore took the precaution to bind the other contracting party to introduce other methods of lighting if desirable; for this paragraph would certainly not have been inserted if the magistrate had wished to reserve the right to introduce every new invention in lighting during the term of contract by evasion of its terms, and thus to make the lighting by the gas-light company unnecessary.

According to the above the city magistrate has no right to take into his own hands, or to commit to another, the use of electricity for public or private lighting of the city of Munich, for which reason the complaint has been rejected.

Experiments with electric street lighting have been made on a larger and smaller scale in various places, and are still going on. Particularly in North America, they seem to have tried nearly all methods, from the little incandescent lamp to the central arc light at the top of a high mast. But electric lighting, even there, has not been adopted into regular practice. In New

York, according to the "Lumière Electrique" of the 6th of September, 1884, there are only 534 electric lights, with 23,084 gas lamps. In Boston, according to the inspection of street lighting on the 31st of December, 1884, there were in all 401 electric lamps, with 9,817 gas lamps, and 2,591 kerosene lamps. In London, the first experiments in electric street lighting were made at the close of the year 1879, on the Victoria Embankment, with 50 Jablochkoff lamps, but this was afterwards given up. On the 1st of April, 1881, there were other experiments with 124 lamps, which were supplied by three different companies. The firm Siemens Brothers voluntarily gave up after the end of one year, when an advance in price was not accorded them. The experiments have since then been partly continued by other companies. An experiment in Holborn Viaduct with incandescent lamps was given up on the 24th of July, 1884, after the contract with the Edison and Swan United Electric Light Company had expired.

On the 11th of February, 1885, there was finally a contract made with the Hammond Electric Light Company for lighting a number of streets with lamps of 30-candle power from the 1st of January, 1886. According to the latest information, this company has been forced to dissolve in the meantime. Electric lighting in London is, at present, very insignificant in comparison with gas lighting. During the year 1884, Fleet Street was lighted with gas intensive lamps by the firm of Sugg & Company.

It was the lighting of the Avenue of the Opera in Paris which, during the exhibition of 1878, caused such great excitement, and brought speculation into a condition of feverish excitement. This lighting continued, under difficulties, for several years, and then when, in

1882, the Société Générale d'Electricité asked for an advance in the price, and a free place to set up its machinery, it was given up. Since then electric lighting in Paris has been entirely given up, and 1,307 gas intensive burners have been set up as street lamps. Add to these 2,160 similar lamps at the entrances of shops, cafés, theatres, etc., and we have in all 3,467 intensive gas burners, which, in intensity, correspond to 29,700 ordinary street gas flames. The number of ordinary gas lamps in Paris was, at the close of 1884, 60,517.

In Germany, the electric street lighting experiments in Berlin must first be mentioned. The first attempts were made in 1882 with 20 incandescent lights in the Kochstrasse, from the Markgrafenstrasse as far as the Friedrichstrasse. These were set up by the firm Siemens & Halske at its own expense. On the 20th of September the experiments in the Leipzigerstrasse and Potsdam Square began with 36 differential arc lights, which the same firm undertook at the expense of the city. At the same time experiments with intensified gas light were undertaken by the city gas factory according to three different systems. In the eastern part of the Leipzigerstrasse, from the Friedrichstrasse to the Commandantenstrasse, on an extent of 600 meters, 54 Siemens' regenerative gas burners No. 2, with a consumption of 750 to 800 liters per hour, were set up on the ordinary candelabra. In the Friedrichstrasse north-erly from the Leipzigerstrasse as far as the Jägerstrasse, a distance of about 390 meters, there were placed on each of the 32 candelabra already there three Bray gas burners with a consumption of together 1200 liters per hour. In the Friedrichstrasse from the Leipzigerstrasse southerly as far as the Kochstrasse, on a territory of 400 meters in length, 30 candelabra already existing were

supplied on the analogy of Lacarrière's system, with six large street burners in a group, and under them was placed a glass plate. The consumption of each burner was 195 liters. In order to temper the transition from the electric light in the Leipzigerstrasse to the ordinary gas light in the cross streets, there were placed in the Wilhelmstrasse, north and south from the Leipzigerstrasse, eight candelabra with Siemens' regenerative burners No. 2, and, in like manner in the Mauerstrasse, six candelabra with the same burners. Finally, in front of the great stairway of the theatre, there were placed two Siemens' gas burners No. 2, and in front of the opera house four of the same.

The electric lighting of the Leipzigerstrasse and Potsdam Square with 36 arc lights has been continued to the present day, but the machinery has been so changed that, instead of the four gas motors which were only lent for a year, and which the factory would not agree to lend longer, a steam-engine has been set up at the cost of Siemens & Halske. An improvement was, however, not obtained by this change; and, after the beginning of the use of the steam-engine, interruptions of the illumination occurred, lasting a longer or shorter time, during which the gas flames which still remained had to be used. On Dec. 4, 1884, in a session of the city government, a proposition of the Städtische Electricitätswerke, then in process of construction, was accepted for lighting the Leipzigerstrasse and Potsdam Square in its present extent, as well as the market-hall between the Zimmerstrasse and the Mauerstrasse, but the city reserved the privilege of giving up this method after two years.

The number of intensive gas burners has in the mean time risen. At the close of 1884 there were 499, as follows:—

255	Bray-burners, consumption	300	liters
16	regenerative burners, consumption . .	200	"
95	" " " . . .	400	"
116	" " " . . .	800	"
17	" " " . . .	1,600	"
<hr/>			
499			

The whole number of public gas-jets was at that time 14,744.

We see from this that electric lighting in Berlin is still an experiment; but that, on the contrary, even if not to such an extent as in Paris, intensive gas burners have had a considerable success.

Concerning the impression which the Berlin experiments in electric street lighting have made, I will quote the utterance of a calm and impartial authority well known to me. He writes, "The impression which the illumination makes is, with various persons, quite different. There are many to whom the light is unpleasant: the bluish light sometimes shading off into gray is not agreeable to many eyes. A large portion of the public naturally is greatly pleased by it. The way in which these flames are lighted is a surprise. When one stands in Potsdam Square and, with one pressure, thirty-six electric lights suddenly burst into flame, the impression is very favorable. But, if I may be permitted to give my opinion, I must confess that the illumination is much more brilliant than is necessary. The lamps stand alternately on one and then on the other side of the place; but, in spite of the great light diffused by each lamp, and in spite of the fact that they are only thirty-five meters apart, it is found that the light is much greater in the immediate vicinity of the lamp than in the space between two lamps. The shadow, too, which is cast by the carriages as they pass is a very black one;

so the alternation of light and darkness is very unpleasant for many. For universal public lighting I do not think that this system can be recommended; for, in the first place, the needful light is far exceeded, and, secondly, on account of the cost."

On the occasion of the negotiations concerning the continuance of electric lighting, the question gave rise to lively discussion among the public, and there was a sort of opposition which dared to show itself in the public press. In the "*Berliner Tageblatt*" there appeared a series of articles with the heading, "The Duties of the City Government," and I consider the objections there uttered so forcible that I cannot omit to give them here.

"That the electric arc light," it reads, "gives a brilliant light; that it makes the streets almost as light as day; that the illumination of Potsdam Square and the contiguous parts of the *Leipzigerstrasse* furnish to strangers, who arrive in the railway trains, a magnificent sight; that it forms an adornment worthy a great city, — on these points there can be but one opinion; and, if it were only a question of allowing a splendid piece of brilliant lighting to remain, there would not be much to say against the great city's permitting itself such a luxury, even if it did cost considerable sacrifices of money. But the circumstances look quite different when the present illumination is regarded as but the beginning, and an extension is to be expected along other populous streets. If this is the intention, then it seems urgently desirable to get rid of the beginning in order to prevent a continuation.

"We demand of a good city government that it should satisfy all reasonable claims as to illumination. When the streets on the darkest nights are so lighted that

everywhere the signs and numbers of the houses can be read from quite a distance, that the smallest objects are visible on the sidewalk, that those who meet recognize each other at a distance, the middle of the street is light enough to prevent all accidents on that account among the teams, — then every reasonable claim is met. To make daylight in the night-time at great pecuniary cost cannot be the duty of the city government, even in the most populous streets.

“It is the duty of the public officers in a city like Berlin, where, on account of the rapid development of the city, the demands on the pockets of the citizens must needs be great, where daily new and enormous financial sacrifices are required by new problems hard to solve, — it is their duty, I say, to weigh carefully whether the sacrifices stand in a proper relation to the advantages obtained, without allowing themselves to be influenced by a brilliant show. Such calm examination the present method of lighting the Leipzigerstrasse could not stand. It would then be seen that, aside from the monetary cost, it works injuriously in every way.

“By the excess of light in one street, a demand for light is excited in the public. The great mass of the public — which is never able to weigh the consequences of its demands, to comprehend the task of the city authorities in its largest sense, and to understand that, by the fulfilment of unreasonable wishes, the burden of taxation must grow infinitely — only sees the brilliant lighting of one street corner, and demands, with an appearance of justice, that other populous streets should enjoy the same advantages. Such demands cannot be refused by the city authorities without incurring the reproach of preferring one part of the city to another. As long as the show in the Leipzigerstrasse is kept up

merely as a show it may remain, — it will do no harm ; but when it is regarded as the beginning of a system of street lighting for Berlin, it will lead to irresistible demands for expansion, and thereby to a large increase in the expense of lighting the streets.

“ There is another danger in connection with electric lighting in its present development, — it is not reliable. It is true that it has happened seldom, but still several times, that the electric light has failed to work, that the lamps have suddenly gone out. It was not a very great misfortune, since the gas lamps were there to take its place ; and, besides that, the private lamps in the shops of the Leipzigerstrasse gave enough light for the moment ; but disadvantages which cannot be estimated would arise from such interruptions if this method of lighting were more widely used.”

We therefore see that in Berlin the electric lighting of the streets is not regarded as an unmixed good or as a necessity, and the present establishments bear still the character of experiments.

I shall not here speak of experiments which have been made on a smaller scale in other cities of Germany. Only a few circumstances can here be mentioned. In the year 1882, the news ran through all the newspapers that Godalming, a little town of 2,000 inhabitants lying between London and Portsmouth, was the first place to give up gas lighting entirely, and take electricity exclusively as a means of illuminating the streets. There were really 7 arc lights and 34 incandescent lights in use for this purpose. But just so loudly as this event was brought forward, just so quietly it disappeared from the scene. The undertakers declared that they could not continue the supply of light at the price agreed upon, and the town went back to gas lighting. Another

little English town, Chesterfield, gave the contract for lighting the streets to an electric company, but is now about to return to gas light.

On the Continent we have the Hungarian free city Temesvár, which was desirous of the honor of possessing the first system of electric street lighting. The contract was made with the Anglo-Austrian Brush Electrical Company in Vienna, and the illumination was actually inaugurated with 731 incandescent lights on the 1st of November, 1884. But the joy did not last long. One interruption came after another. At the beginning of March, there was an interruption in the working, ostensibly on account of the heating and bending of a journal-box; in April, an interruption was excused on account of the stopping of the draught in a chimney; on the 15th of May, the lights went out during a thunder-storm without any explanation; and on the 23d and 24th of May again, not a lamp was burning, because "an operation must be carried on to prevent the heating of the machinery." The dissatisfaction in Temesvár is universal. There are complaints of the frequent interruption, and also of the weakness of the electric light. The Temesvár papers contain emphatic protestations. For instance, the "*Neue Temesvár Zeitung*" of the 27th of May, under the heading, "The Illumination Misery," writes, "A considerable time has passed since the introduction of electric light into our city. We have been silent on the subject of the various interruptions which took place at the beginning, for these were excused on the plea that such troubles usually took place in the beginning of enterprises of that kind. We were also silent when these interruptions were repeated later, but now the affair begins to look serious." On the 24th of May the "*Temesvár Zeitung*" writes, "That the hopes of the

company who undertook this enterprise with so much flourishing of trumpets must be thoroughly disappointed is self-evident. The governments of the cities of Belgrade, Hermannstadt, Theresiopel, Berskerek, etc., who came to Temesvár to become acquainted with the electric light with a view to its introduction in their own cities, went away quite disappointed, and are now a part of them engaged in the construction of gas factories, and a part in negotiations for them. In Temesvár, too, all efforts to reintroduce the electric light have been vain, in spite of the fact that one company offers to supply the light during the time it is required for public lighting at the same price as gas, since public lighting begins almost two hours later than private lighting. But confidence is wanting most of all. The municipal government even gives up the clause in the contract which provides that the theatre and public buildings shall be supplied with the electric light before private citizens, since it is anxious that others should first make a trial of it."

In Germany the little bath and water-cure town of Triberg in the Black Forest of Baden, which, up to the present time, only had a scanty kerosene illumination, resolved to adopt the electric light, and nine arc lights have been set up, which are operated by water-power which is at hand in abundance.

If the question of electric lighting is agitated in earnest here in Munich, it can only be according to section 16 of the contract, with reference to the problem whether the electric light really is more satisfactory in respect to brightness, purity, or steadier burning of the light, or in regard to cheapness. In case this were found to be true, the company would be bound, upon the expressed wish of the magistracy, after a fair agreement in pro-

portion to the lower cost of production, to introduce the new method into city and private use, if the same had been found of practical use on a large scale.

It is universally acknowledged that our present street lighting is very defective, and that it does not, by a great deal, satisfy just demands. Here and there, among the public and in the press, we meet with the opinion that the company is responsible for this; but a glance at the contract will show that the gas company has only to carry out the orders of the city government, and that the responsibility rests with the city magistracy alone. Our street lamps are not only placed at greater distances from each other, but the gas flames also are smaller, and the number of hours which they burn is less, than in other great cities. We have in Munich, for example, not half the street illumination which Berlin has. The Berlin city gas works supplied in the fiscal year 1883-84, according to the annual report, 14,107 street lamps, having a length of pipe amounting to 614,256 meters. In Munich, we had in the past year 3,429 lamps, having a length of pipe of 214,201 meters, and the whole year's consumption of the street lamps was 1,004,573 cubic meters. In this way the gas used for street lamps may be estimated as follows:—

Berlin	683 cubic meters yearly
Munich	293 “ “ “

and per meters of pipes or length of streets,—

Berlin	16 cubic meters
Munich	4.7 “ “

There is no doubt that something must be done to improve the present conditions here; but that it is, therefore, a necessity to introduce electric street lighting, certainly no one can maintain. I am of the opinion, that,

by the use of larger flames in general, and by an increase in the hours of illumination, and bringing a part of the lamps nearer together, as well as the use of intensive burners in appropriate places, the call for more light can be answered in the simplest way. This would correspond to the progress in the same direction actually made in other great cities, and which may be looked at as the real result of electric-lighting experiments. As to whether electric lighting could be introduced at a lower price than an improved system of gas lighting fulfilling all reasonable demands, I beg to withhold any opinion for the present.

Only one point now remains for me to touch upon, which interests you particularly as stockholders in the gas company; namely, the question whether electric lighting, up to the present time, has injured gas lighting, and what is to be expected in future in this particular.

As far as Munich is concerned, I can inform you that gas production has increased this fiscal year by 558,560 cubic meters, or 5.75 per cent. This is one of the most rapid increases which we have recorded during the existence of the company. We cannot only find no injurious influence, but, on the other hand, the effect might be called beneficial. The average consumption of a gas-jet has been this year 77 cubic meters where it was 75 cubic meters last year. Munich is, therefore, better lighted to-day than ever before. We have used 2.7 per cent more light than in 1883-84.

The effect is similar in other cities. In Berlin the production of gas has risen from 68,452,000 cubic meters in 1882-83 to 70,556,000 cubic meters in 1883-84; that is, has risen by 2,104,000 cubic meters, or 3.07 per cent. The average consumption of a jet was 104.5 to 103.3

cubic meters in the former year. Besides that, we read in the annual report, "No gas-light apparatus has been entirely driven out of use by the electric light, since gas has been retained as a reserve in case of interruption of the electric current, and for the lighting of single rooms, or for the purpose of motive power."

In Cologne gas production rose from 13,447,880 cubic meters in 1882-83 to 14,161,040 cubic meters in 1883-84; that is, 713,160 cubic meters, or 5.3 per cent. In the annual report we read the following: "To-day we still maintain the view that electric lighting will only aid gas lighting. Especially is the example of great cities such as Paris and London encouraging to the gas industry. In Paris the consumption of gas grows extraordinarily: electric lighting shows rather a decrease than an increase. While a few years ago gas was represented as the light of the poor man alone, and public lighting was supposed to be given up to electricity: at present facts show the contrary. But electric lighting has increased the desire for light, and has thus called forth a larger consumption of gas in street lighting."

According to the last report of the Deutsche Continental-Gesellschaft, the production of gas in the factories of the company rose from 26,904,612 cubic meters to 29,466,133 cubic meters; that is, 2,561,521 cubic meters, or 9.52 per cent. "It is very gratifying to observe," says the report, "that consumption has risen, especially in the past three years, in a much greater proportion than the number of jets. The increasing habit of intenser lighting undoubtedly plays the chief part in this, and we must probably recognize it as an indirect result of electric lighting in increasing the universal demand for light. The average consumption per flame and year was 107.1 cubic meters against 100.8 the year before."

The Thuringian Gas Company in Leipzig notices in its last report a rise in gas production of 567,562 cubic meters, or 10.69 per cent, and says in connection with this, "However gratifying this may be in itself, it is still more so in view of the fact that other methods of lighting, particularly cheap petroleum and costly electricity, are constantly trying to curtail the existence of gas. Besides that, we learn from the report the following: "On the part of a company for applied electricity, having its seat in Berlin, we received, at the beginning of last year, the proposal to unite with it in constructing electric-lighting plants for a particular district. We thought that we ought not to reject the proposal, since it did not call for great pecuniary outlay or responsibility, and gave us an opportunity to become acquainted with the operations of electric lighting. Experience taught us, in the mean time, that a business advantage could not at present be obtained from the enterprise, and we considered it a duty to consent to the silent dissolution of our relation with the above-mentioned company."

In London the use of gas has, in 1883, risen to 710,000,000 cubic meters, and has augmented in the city itself 4 per cent, and in the suburbs 6.76 per cent, in comparison with the year before.

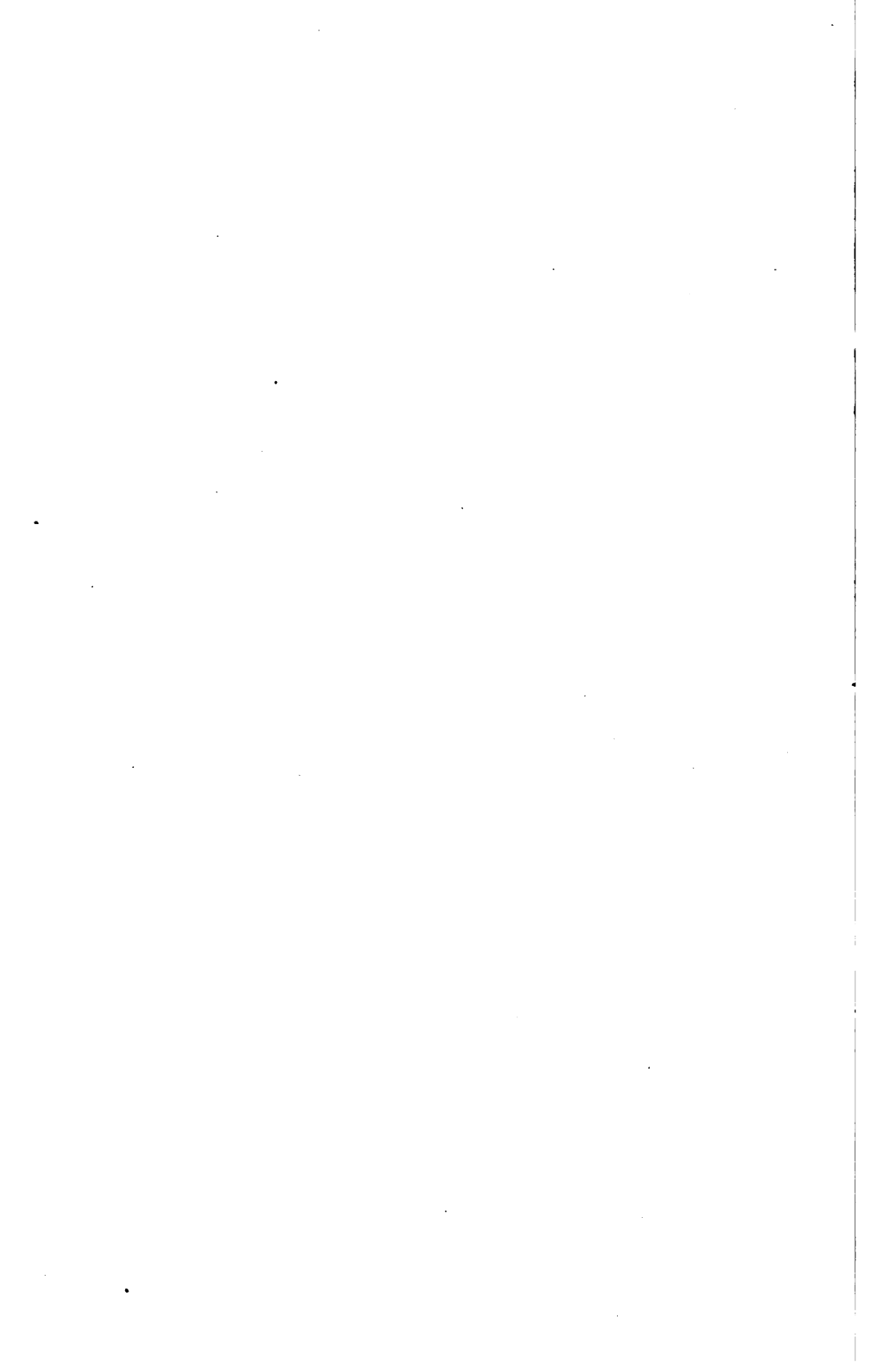
In Paris, in the year 1883, 283,864,400 cubic meters of gas were consumed,—8,495,695 cubic meters, or fully 3 per cent more than in the preceding year.

In America, also, the reports of the gas companies on the increase of gas consumption are similarly encouraging.

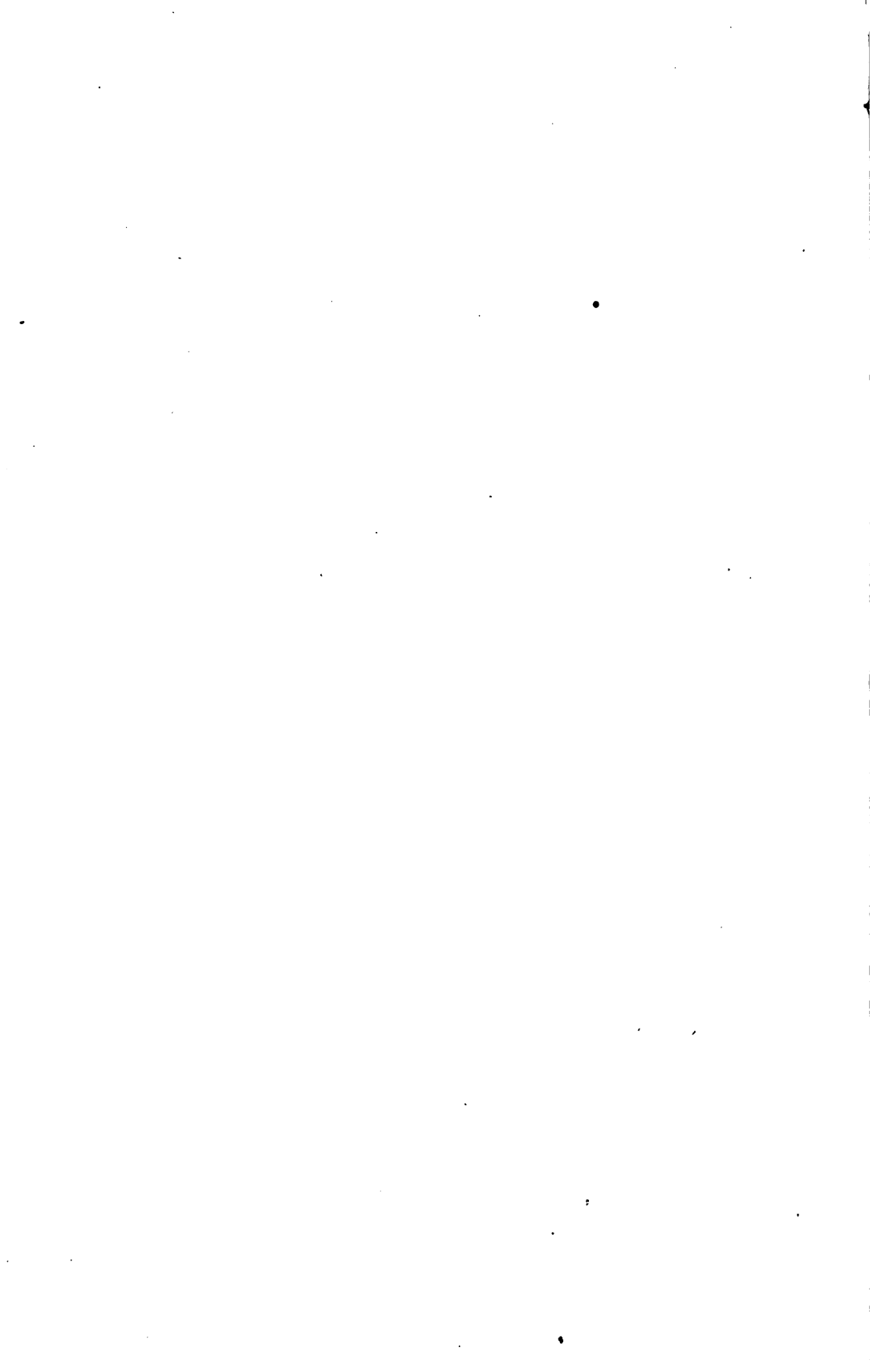
So we see that, at the present time, the views are confirmed which I have always expressed, not only as

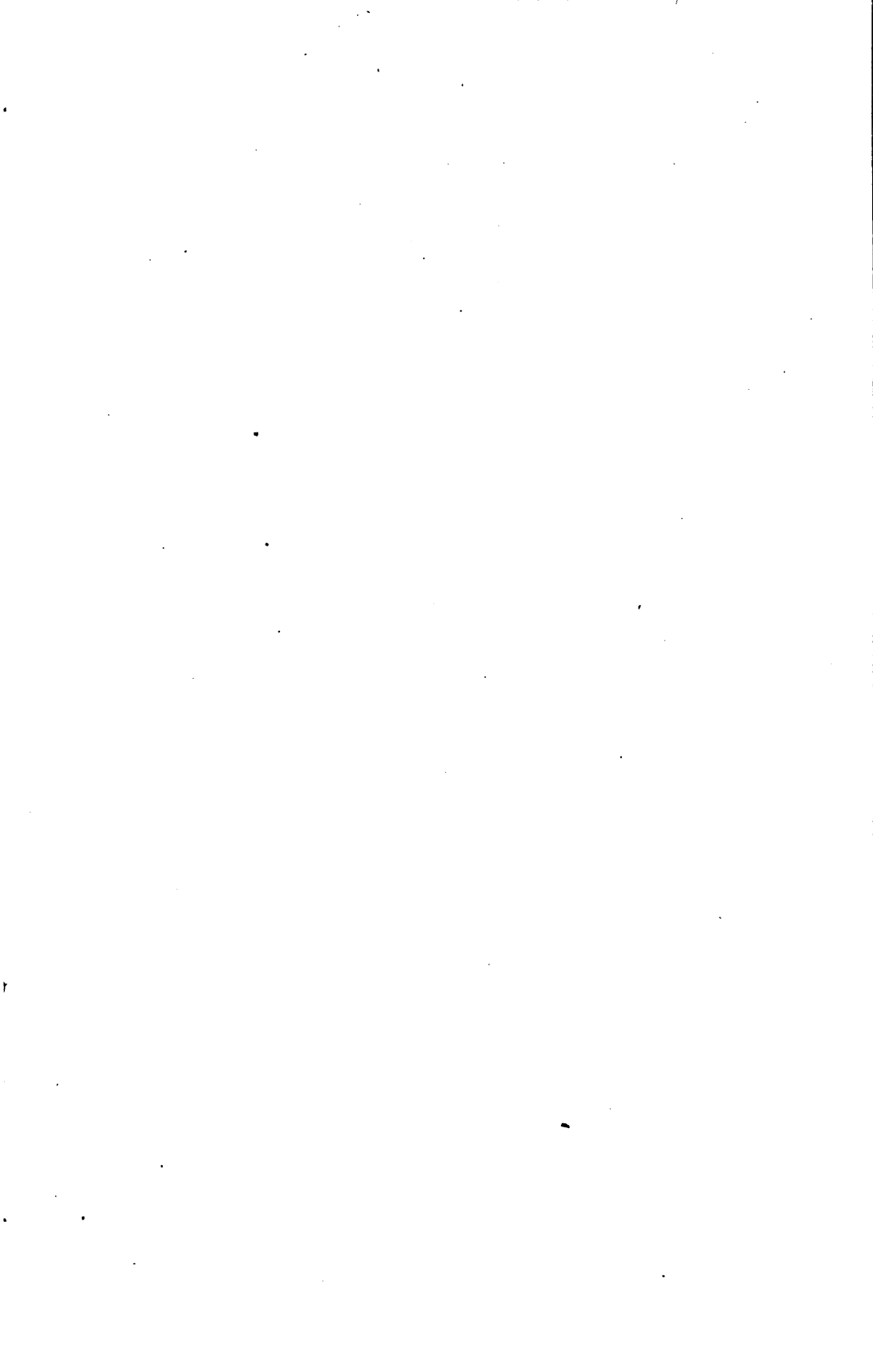
my own, but also as those of every gas-technologist. The electric light is no enemy to gas lighting, but both can and will exist peaceably together. The electric light will, and ought to, obtain the extension which it deserves by its nature; but gas will remain in future, as it always has been, the universal means of illumination; and, as far as the electric light helps to increase the general wish for light, gas light will only be aided by it. What must be fought against is the undue laudation, the excitement brought forth by unhealthy speculation, which puffs itself up unduly and injuriously to others. It is not enough that, every time one of its lamps is set up, the event is described as a step in progress, and in general every little occurrence in the realm of electricity is described in the most glowing colors; nay, circumstances are disfigured and misrepresented, and gas lighting is described as a defective, unbearable method of illumination, injurious to health,—and all this in order to glorify the sanitary advantages of the electric light.

The unhealthy growths of the business must be pruned away; and the sooner and more thoroughly this takes place, the sooner will the meritorious efforts of science and technology be once more recognized, and credit return to legitimate industries.







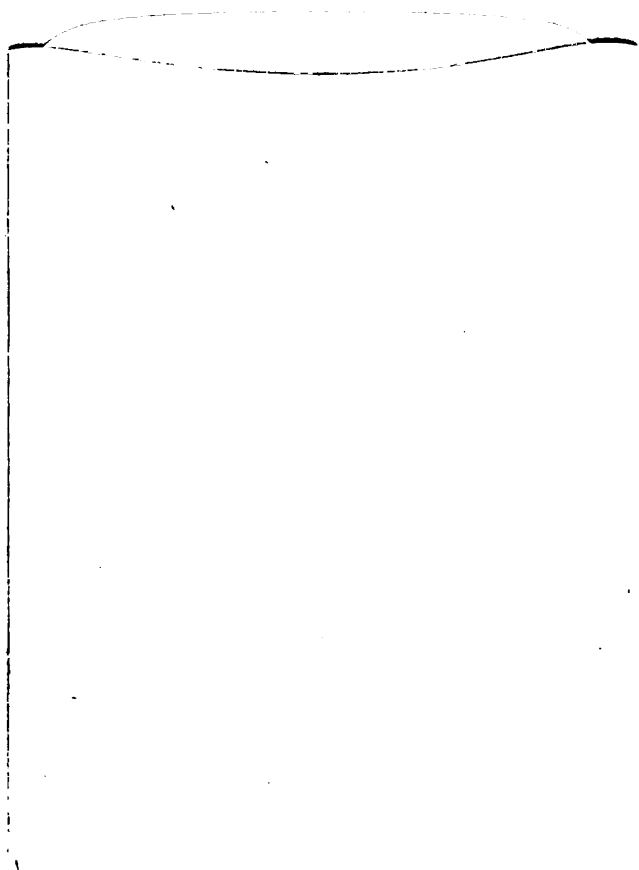




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